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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/774,417	02/10/2004	Yoshiki Nishibayashi	50212-559	1031
7590 McDermott, Will & Emery 600 13th Street, N.W. Washington, DC 20005-3096		01/09/2008	EXAMINER OLSEN, ALLAN W	
			ART UNIT 1792	PAPER NUMBER
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/774,417	Applicant(s) NISHIBAYASHI ET AL.	
	Examiner Allan Olsen	Art Unit 1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 May 2007 and 31 May 2007.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3,4 and 12-18 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3,4 and 12-18 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 04 August 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☒ Certified copies of the priority documents have been received in Application No. 09/995,854.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION***Continued Examination Under 37 CFR 1.114***

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on October 31, 2007 has been entered.

In applicant's submission filed on October 31, 2007, all claims are drawn to the same invention claimed in the application prior to the entry of the submission under 37 CFR 1.114 and could have been finally rejected on the grounds and art of record in the next Office action if they had been entered in the application prior to entry under 37 CFR 1.114. Accordingly, **THIS ACTION IS MADE FINAL** even though it is a first action after the filing of a request for continued examination and the submission under 37 CFR 1.114. See MPEP § 706.07(b). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

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the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Drawings

The drawings are objected to because in the remarks filed May 2, 2007, applicant noted that the fourth and fifth columns of Figure 10, which respectively represent the total atom percent of carbon and the total atom percent of fluorine, should reflect the 1:4 carbon to fluorine ratio of CF₄. This ratio is reflected in each row except for: Comparative example1, Example1 and Example5. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and

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informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Response to Applicant's Remarks Regarding the Drawing Objection

Applicant's reply stated:

FIG. 10 is objected to because the fourth and fifth columns should reflect the 1:4 carbon to fluorine atomic ratio of CF_4 . This rejection is traversed.

The Office Action, at page 2, asserts that three rows do not reflect this ratio: comparative example 1, example 1, and comparative example 2. First, please note that comparative example 2 does reflect a ratio of 1:4, because the stated ratio of 0.005:0.02 is equivalent to a ratio of 1:4. Second, the other two rows reflect ratios of approximately 1:4. Specifically, comparative example 1 stated ratio of 2:9 is approximately 1:4. Further, the example 1 stated ratio of 1:6 is also approximately 1:4. It appears that comparative example 1 and example 1 were performed at approximately 1:4, but with a slight excess of fluorine atoms.

The previous amendments to FIG. 10, filed May 2, 2007, were predicated upon clear typographical errors (a decimal point in the wrong position). However, there do not appear to be any clear typographical errors in the data presently objected to. Thus, Applicants submit that FIG. 10 appears to accurately reflect the experimental data, and that the objection should be withdrawn.

The Examiner agrees with applicant's first point that the stated ratio of 0.005:0.02 accurately reflects the 1:4 ratio of C and F in CF_4 . Example5, rather than "Comparative example2", should have been cited as the third case that does not satisfy the 1:4 ratio of CF_4 .

Applicant's second point is that the data in question reflect ratios of approximately 1:4 and that "[i]t appears that comparative example 1 and example 1 were performed at approximately 1:4, but with a slight excess of fluorine atoms". However, the C:F ratio in CF₄ is a fixed value - CF₄ it is not subject to, nor capable of providing a slight excess of either fluorine or carbon. If, applicant suggests, the ratios presented in Figure 10 are correct, then there must have been an additional source of fluorine atoms. However, the specification does not disclose or suggest using a mixture of two fluorine containing gases (e.g., CF₄ + at least one of HF, F₂, SF₆, NF₃ or other fluorocarbon). In the absence of a legitimate source for the "slight excess of fluorine atoms", the examiner maintains that the ratio between columns 4 and 5 of figure 10 should reflect the rigid 1:4 ratio of CF₄.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1, 3, 4 and 12-18 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. As outlined below, various claims contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention.

Regarding claims 1, 3, 4 and 12-16, it is noted that independent claims 1 and 12 each recite "supplying a electric power of less than 1.0 W/cm^2 ". It is further noted that the specification includes two examples wherein a power level of less than 1.0 W/cm^2 is used. However, there is no general disclosure pertaining to the entire range of "less than 1.0 W/cm^2 ". Should one skilled in the art expect applicant's disclosed process to function when supplying, for example, a power as low as of 0.05 W/cm^2 or just 0.01 W/cm^2 ?

Regarding the limitation of claim 1, this reads:

wherein said mixed gas contains nitrogen gas in an amount such that the intensity ratio A/B of said mixture is greater than the intensity ratio A/B of pure oxygen, where A is the intensity of an emission peak caused by atomic oxygen and B is the intensity of an emission peak caused by molecular oxygen

The examiner notes that the disclosure contains contradictory data on this point. The contradiction stems from the fact that figure 5 and figure 6 each present a different A/B value for pure oxygen. Figure 5 provides an A/B value for pure O_2 of 2.5. On the other hand, figure 6 provides an A/B value for pure O_2 of 2.1. Furthermore, figure 6 presents data showing a maximum A/B ratio of about 2.4 is obtained from a gas comprising 1% CF_4 in O_2 also contains about 8 % N_2 . Herein lies the problem, claim 1 requires that nitrogen be provided in an amount such that the A/B ratio exceeds the A/B ratio of pure O_2 . However, the maximum A/B ratio of 2.4 depicted in figure 6 is less than the A/B ratio for pure oxygen that is shown in figure 5. The variability of the claimed target value is very problematic. The examiner notes that the increase in the A/B ratio over that which is obtained from a pure oxygen plasma, is clearly the result of having added CF_4 the O_2 . Figure 6 demonstrates that one can add up to 40% nitrogen

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to a gas of 1 % CF₄ in O₂ without the causing the A/B value to drop below the value that is obtained for the same gas of 1% CF₄ in O₂ before adding N₂. Perhaps claims focusing on that aspect may be more useful.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 3, 4 and 12-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over the paper by Shiomi, "High-Rate Reactive Ion Etching of Diamond and Fabrication of Porous Diamond for Field-Emission Cathode", in New Diamond, Vol. 13, No 4. pp 28-29, in view of US Patent 6,261,726 issued to Brooks et al. and further in view of US Patent 6,013,191 issued to Nasser-Faili et al. (hereinafter, Shiomi, Brooks and Nasser-Faili, respectively).

Shiomi teaches the reactive ion etching of a masked diamond surface. Shiomi teaches the mask comprises aluminum (page 2, line 17 of translation). Shiomi teaches that diamond is etched by a plasma of 100% O₂. Shiomi teaches that the plasma may alternatively comprise NO₂ or N₂. Shiomi teaches that the angle of the sidewall can be controlled by adding CF₄ to the etchant. Shiomi teaches that vertical sidewalls can be obtained by adding a very small amount of CF₄. Shiomi teaches using a CF₄ concentration as low as 0.125% (page 5, line 2).

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With respect to independent claims 1 and 12, Shiomi does not teach supplying less than 1.0 W/cm^2 of power to the RIE process. With respect to independent claims 17 and 18, Shiomi does not teach supplying at least 0.45 W/cm^2 of power to the RIE process. Shiomi does not teach using a both O_2 and N_2 in the plasma gas.

Brooks teaches etching diamond with a mixture of O_2 and N_2 . See column 6, line 63.

Nasser-Faili teaches etching diamond within various types of plasma chambers and under a variety of process conditions. Nasser-Faili teaches using a power density of "about 1 W/cm^2 " which encompasses the claimed "less than 1.0 W/cm^2 " and the claimed "at least 0.45 W/cm^2 ".

It would have been obvious to one skilled in the art to etch diamond with plasma comprising O_2 and N_2 and a fluorine-containing compound because Shiomi teaches using either O_2 or N_2 and "[i]t is prima facie obvious to combine two compositions each of which is taught by the prior art to be useful for the same purpose, in order to form a third composition which is to be used for the very same purpose."¹ Furthermore, because Shiomi teaches etching diamond with an O_2 plasma while Brooks teaches etching diamond with an O_2/N_2 plasma, a person having ordinary skill in the art would recognize an O_2 plasma and an O_2/N_2 plasma as being functionally equivalent with respect to the etching of diamond.

It would have been obvious to one skilled in the art to add fluorine to the O_2/N_2 mixture of Brooks because Shiomi teaches that the addition of fluorine allows one to

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gain control over the etching profile. Additionally, in view of Nasser-Faili's teaching, the skilled artisan would have reasonable expectation of success because Nasser-Faili demonstrates the etching of diamond with plasma comprising oxygen, nitrogen and a low fluorine content.

It would have been obvious to one skilled in the art to apply power with a power density of at least 0.45 W/cm^2 because Nasser-Faili teaches that by supplying 1.5 W/cm^2 of power, one can obtain vertical structures similar to those obtained taught by Shiomi.

Regarding the newly added limitation that requires providing a sufficient amount of nitrogen to the gas mixture so that the ratio of the emission intensity of oxygen atoms to the emission intensity of molecular oxygen is greater than it would be in pure O_2 plasma, the examiner notes the well-established principal that the ratio of atomic oxygen to molecular oxygen ($\text{O}:\text{O}_2$) increases when fluorine is added to an oxygen plasma (See, for example, IBM Technical Disclosure Bulletin NN8712128). As such, using the gas mixture made obvious by Shiomi, Brooks and Nasser-Faili one would expect the A/B emission ratio to be greater than that which would be obtained from a pure O_2 plasma.

Response to Arguments

Applicant's arguments filed October 31, 2007 have been fully considered but they are not persuasive.

¹ *In re Kerkhoven* 205 USPQ 1069 (CCPA 1980). Cites *In re Susi* 169 USPQ 423, 426 (CCPA 1971); *In re Crockett* 126 USPQ 186, 188 (CCPA 1960). See also *Ex parte Quadranti* 25 USPQ 2d 1071 (BPAI 1992).

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Applicant has based their arguments upon the wrong Shiomi reference. The rejection relies upon the paper by Shiomi, "High-Rate Reactive Ion Etching of Diamond and Fabrication of Porous Diamond for Field-Emission Cathode", in New Diamond, Vol. 13, No 4. pp 28-29. This reference was cited by applicant on the IDS submitted February 10, 2004. The reference that applicant is relying upon to argue against the rejection is the Shiomi article that was cited, by applicant, with the IDS that was filed on March 10, 2006.

Applicant's remarks request clarification as to what part of Shiomi the examiner is relying upon because applicant believes Shiomi to be only a 4 page document while the examiner cites to page 5 of Shiomi. As, the citation of Shiomi indicates, the Shiomi reference being relied upon is actually only a 2 page document in the original Japanese language. The examiner's cite to page 5 is in reference to the English language translation which is believed to have also been provided by applicant.

Regarding claim 15, applicant argues:

As stated above, independent claim 15 recites, in pertinent part, "diamond product having a projection or a depression on a surface thereof, the projection or depression having at least one side face with an angle of inclination of at least 78 degrees."

The Office Action does expressly discuss this angle of inclination feature of claim 15. Thus, Applicant submits that this feature is not disclosed by the cited art.

Thus, at a minimum, the combination of Shiomi and Brooks Nasser-Faili fails to teach or suggest the forgoing limitation, and therefore does not render independent claim 15 obvious.

As before, the examiner notes that the transmission electron photomicrographs of Shiomi (figure 5) and Nasser-Faili (figure 1) both depict features having angles of

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inclination of at least 78 degrees. Furthermore, the above rejection states the Shiomi teaches that vertical sidewalls can be obtained

Conclusion

This Office action follows applicant's request for continued examination. In this RCE, all claims are drawn to the same invention claimed in the earlier application and could have been finally rejected on the grounds and art of record in the next Office action if they had been entered in the earlier application. Accordingly, **THIS ACTION IS MADE FINAL** even though it is a first action in this case. See MPEP § 706.07(b). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no, however, event will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the

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shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Allan Olsen whose telephone number is 571-272-1441. The examiner can normally be reached on M, W and F: 1-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on 571-272-1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.



Allan Olsen
Primary Examiner
Art Unit 1792